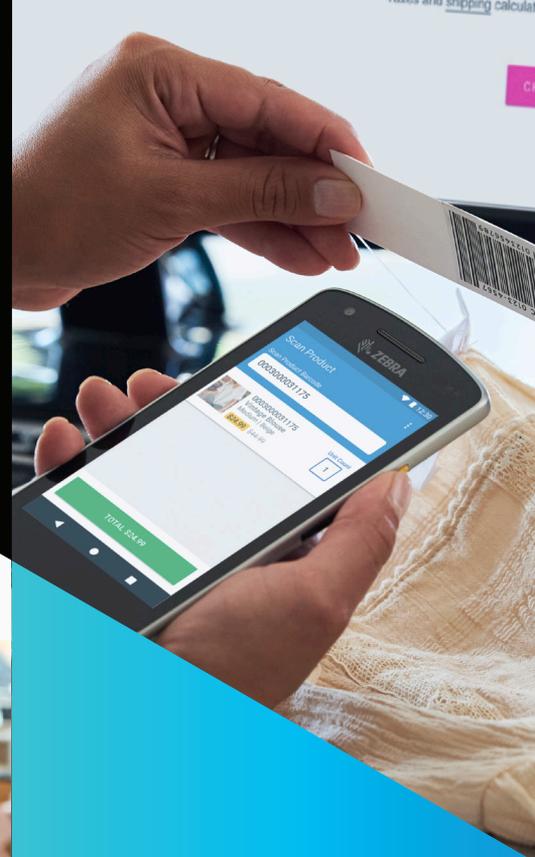**ZEBRA** CAPTURE YOUR EDGE

Is Camera Scanning Negatively Affecting Your Business?

An independent 3rd party's comparative analysis of barcode scanning methodologies—enterprise, integrated scan engines and consumer-based camera decoding

While at first glance choosing consumer devices appears to be a viable low-cost solution, the study found enterprise devices purpose-built for your work environment were proven to positively impact performance, productivity, cost and ergonomics.

From Ergonomics To Scan Rates— The Resulting TCO Impact On Mobile Deployments.

Selecting the right mobile device for your workforce is a critical decision because the device you choose will have a big impact on the return on investment in your mobility strategy. Choosing the wrong device can lead to increased costs, decreased productivity, and frustration among your frontline workers. When it comes to mobile barcode scanning, choosing a device comes down to two options: enterprise devices with integrated scan engines or consumer devices with camera-based scanning.

An independent third-party study

In order to test the impact of enterprise devices, Zebra Technologies commissioned a study with United States Ergonomics, a consulting company that provides workplace and product ergonomic services. The study tested enterprise mobile computers with integrated barcode scanning technologies (like those offered by Zebra Technologies) in a number of fulfillment-based scenarios simulating "buy online, pick up in-store" (BOPIS) and rack-based picking tasks. These rugged integrated scanning systems were compared to consumer phone-camera devices using the built-in camera and a third-party scanning app (Scandit®).

Putting front-line workers to the test

The purpose of the study was to assess the impact these devices had on worker productivity and effort while performing order fulfillment tasks. The tests measured:

- **Speed and efficiency** of completing orders, the physical demands of device usage
- **User's feedback** on comfort, performance and efficiency

The test methodology accounted for factors such as task efficiency, aiming accuracy, screen interaction and overall ergonomic performance, including worker effort, with the aforementioned combination of devices and scanning methods in common scan-intensive workflows.

The enterprise device advantage

These tests established the benefits of integrated and optimized enterprise-grade scanning technology versus off-the-shelf consumer-grade camera scanning technology for scan-intensive enterprise workflows. Benefits included faster task completion time, reduced worker effort, and increased worker comfort that ultimately will positively impact the Total Cost of Ownership (TCO) of the mobile deployment solution.

The Testing Process

United States Ergonomics created a testing module putting different devices to the test. Through a simulated "buy online, pick up in-store" (BOPIS) rack-based picking situation we were able to compare the ergonomic performance of different scanning devices.

Participants

12 professional in-store order pickers (4 male/8 female) all had experience with hand-held mobile computers and/or barcode scanners, though most were not certain of which brand they had used.

Devices

They participated in order fulfillment scenarios featuring four different devices yielding five device modality combinations (the Samsung XCover Pro was used in two modalities, on-screen actuation and side trigger actuation). Two were Zebra Technologies devices—**the Zebra TC52ax** with scanning via the integrated scan engine located at the top of the device, and the **Zebra EC55** with scanning via the integrated camera on the back of the device. The consumer-grade devices included the Samsung XCover Pro and the Apple iPhone SE. Both were running a Scandit SDK application and used the built-in rear camera for scanning solutions.

Testing Methodology

As users went through our process, performance metrics were collected for the test tasks as follows:

- Pick completion times (efficiency)
- Muscle exertion using electromyography
- Dynamic wrist posture measurement using electrogoniometry
- Subjective feedback for ease of use, comfort, fit, effort, efficiency and product attributes such as weight, balance, size and triggering
- Overall product ranking

Subjects were fitted with electromyography (EMG) sensors to measure and track muscle usage and strain with different types of scanning ability. A five-shelf picking task scenario was simulated, with participants completing three unique pick assignments with each scanner. Subjects followed a printed picklist mounted to the cart. The fulfillment center mock-up contained four aisles and all picklists contained pick locations from each aisle. There were five shelf heights and pick locations ranged across all heights. Test orders of scanners were randomized with each scanner tested an equal number of times, however, the picklist was constant. Barcode scanning was triggered by either pressing a physical side button (Zebra and Samsung) or by using the on-screen virtual button (Zebra, Samsung and Apple).

Each test's operation was as follows:

- Scan cart to begin picklist
- Scan item location
- Scan each of the items listed on the picklist (ranging from 1-6)
- Scan the bin listed on the picklist
- Place items in respective bin

How Did Zebra Enterprise Devices Stack Up Amongst The Rest?

Just How You'd Expect.

A Zebra enterprise device with an integrated and dedicated scan engine paired with a physical side-scan button performed best overall, resulting in measurable gains in speed and efficiency, reduced physical demands and very favorable usability ratings:

25%–40%   **Faster pick times** than the consumer device camera systems

23%–48%   **Less muscle work** with lowest physical demand

30%–60%   **Less postural demands** than the consumer device-camera systems

Superior user perception across all survey categories including overall performance, ease of use, efficiency, durability, weight, size, comfort, and other criteria.
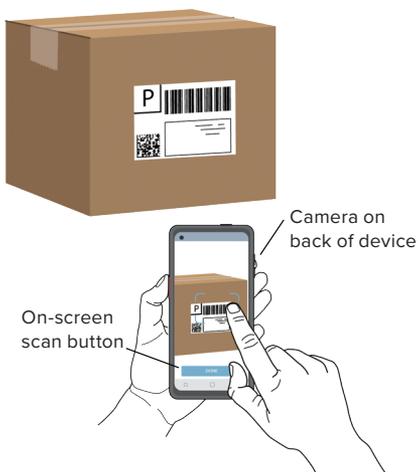
A number of factors contributed to the efficiency of the enterprise scanning modality:

- The integrated scan engine position at the top of the device and aimer resulted in lower physical and postural demands allowing users to simply point and shoot with a physical side activation button as opposed to using the device screen to ensure the barcode is in the field of view.
- The device is palm-balanced with a natural thumb placement which is preferred by end-users.
- The integrated scan engine and aimer pinpoint the barcode and hit the target faster without having to line up and rely on the screen.
- Reduced visual dependence on the mobile computer screen for interaction (e.g. actuation, zooming). Consumer devices require a continuous transfer of attention from the viewfinder to the item to be scanned.
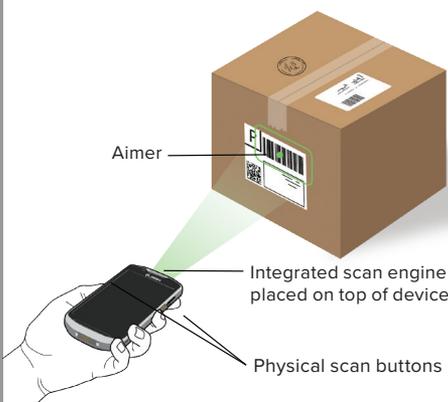
On the other hand, consumer devices:

- Are built for consumer image and video capture needs and as such rely on finger balancing.
- Require awkward wrist positions when scanning low or high items
- Consumer devices lack side imager triggers, which help expedite scanning in use cases such as restocking.
- Require visual dependency on the screen for the end-users to ensure the barcode is within view.

Camera-Based

Camera on back of device

On-screen scan button

Integrated Scan Engine

Aimer

Integrated scan engine placed on top of device

Physical scan buttons

Which device had the highest scan rate?

When considering scan rates in a picking / fulfillment workflow, the integrated scan engine located on the top of the device and the scan triggered by the side button (Zebra TC52ax) resulted in the highest scan rate (Scanning times below calculated from the hourly scan rate based on the workflow as outlined in The Testing Process below.).

- Zebra TC52ax is 35%, or 1.53 times faster than Samsung XCover Pro (Virtual Button) (3.66 secs. vs. 5.59 secs.)
- Zebra TC52ax is 39%, or 1.65 times faster than Samsung XCover Pro (Physical Button) (3.66 secs. vs. 6.04 secs.)
- Zebra TC52ax is 25%, or 1.33 times faster than the Apple iPhone (Virtual Button) (3.66 secs. vs.4.88 secs.)
- Zebra TC52ax is 30% or 1.42 times faster than Apple/Samsung (Camera, virtual button)

How might these results impact the TCO of a Mobile Computing Deployment with scanning workflows?

In our experience with retailers and typical retail workflows, a typical retailer might on average target an employee performing a picking / fulfillment workflow to be tasked with 200 scans in an hour. Based on the outlined workflow, the scan time results can then be extrapolated to project the time to complete a picking / fulfillment workflow scenario of 200 scans/hour.

41.36 minutes a day saved on scanning

200 Scans per Hour Picking / Fulfillment Workflow	Time to Complete Workflow (Mins.)	Time to Complete Workflow (Hours/Day)	Time Saved/ Day (Mins.)
Integrated Scan Engine with Physical Button (3.6 secs./Scan)	12.19	1.63	41.36
Camera with Virtual Button (5.21 secs., Average between two virtual button devices)	17.36	2.48	

Getting the job done faster

The time saved per worker, per day, from using an integrated scan engine with a physical trigger button, over a consumer device with a camera and a virtual button is 41.36 minutes. This is significant in that 41 minutes per day, per worker, or 30% more time, can be used to repurpose associates for other value-added tasks or to increase the number of picking / fulfillment scans.

Testing Results

## Time to Complete Order Pick
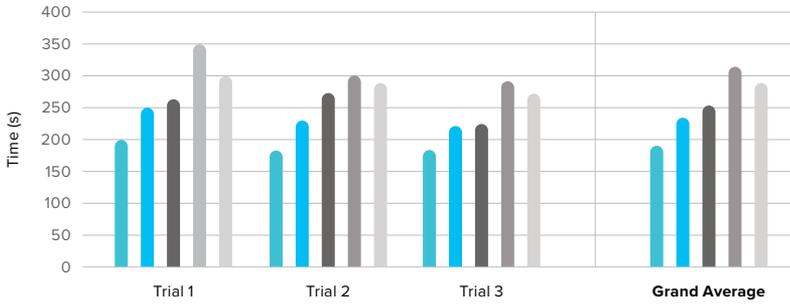
Scan Rate Comparison

Device	Avg. Hourly Pick Rate
Zebra TC52AX (Physical Button, Integrated Scanner)	984.1
Zebra EC55AK (Physical Button, Camera Scanner)	798.4
Apple iPhone SE (Virtual Button, Camera Scanner)	737.7
Samsung XCover Pro (Physical Button, Camera Scanner)	644.5
Samsung XCover Pro (Virtual Button, Camera Scanner)	595.9

Conclusion

The fastest pick time was achieved with the integrated scan engine located on the top of the device and the scan triggered by the side button (Zebra TC52ax). It resulted in scans 25%—40% faster than the consumer device-camera systems. The speed and consistency of the Zebra TC52ax also resulted in the fastest scan rate.

The physical demand of the scanning process was also tracked. Lower totals of muscle work and postural demand correspond to increased worker productivity, reduced muscle fatigue and improved ergonomics. Overall, the lowest physical demand levels were achieved with the integrated scan engine located on the top of the device and the scan triggered by the physical side button (**Zebra TC52ax**). This device required 23%—48% less muscle work and up to 60% less postural demands than the consumer phone-camera systems.
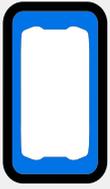
Perceived Physical Exertion (Lower=Less Effort)
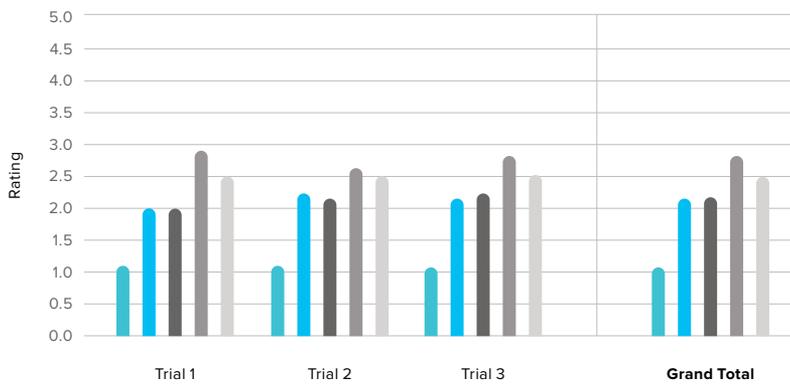
- Zebra TC52AX (Physical Button, Integrated Scanner)
- Zebra EC55AK (Physical Button, Camera Scanner)
- Apple iPhone SE (Virtual Button, Camera Scanner)
- Samsung XCover Pro (Physical Button, Camera Scanner)
- Samsung XCover Pro (Virtual Button, Camera Scanner)

Conclusion

Post-trial, users rated the imaging scan engine with scan engine location on the top of the device and the scan triggered by the side button (**Zebra TC52ax**) superior to the over devices, with only **half the effort required when compared to the other devices.**

79.2% of users ranked the integrated scan engine with a physical button on Zebra TC52ax first out of five devices across the following performance categories:

- **Aiming accuracy**
- **Maneuverability**
- **Manipulation required to scan**
- **Barcode pick-up distance**
- **Efficiency**
- **Overall performance**

Overall Percentage Ranked 1st Across All Categories
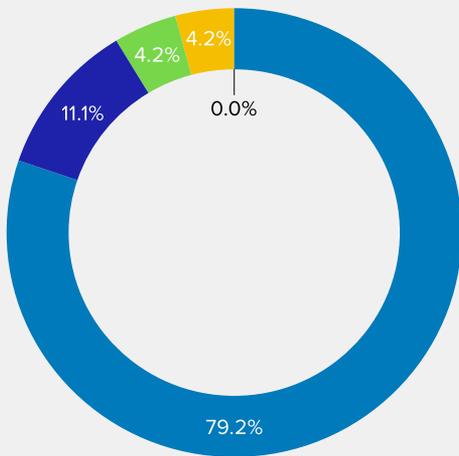
- Zebra TC52AX (Physical Button, Integrated Scan Engine)
- Zebra EC55AK (Physical Button, Camera Scanner)
- Apple iPhone SE (Virtual Button, Camera Scanner)
- Samsung XCover Pro (Physical Button, Camera Scanner)
- Samsung XCover Pro (Virtual Button, Camera Scanner)

User Perception

Upon completion of the testing, candidates were given surveys on the physical device features and performance, along with their hand-arm comfort. Across the board, there was a clear winner—the **Zebra TC52ax**. It was rated on a 1–5 scale, being near a 5 in:

- Aiming accuracy
- Maneuverability
- Manipulation required to scan
- Barcode pick-up distance
- Efficiency
- Overall performance

On the other end of the spectrum, consumer phone-camera devices had low to moderate ratings across most categories including durability, aiming accuracy, ease of use, scanning distance and more. Leading to the majority of users (79.2%) ranking the **Zebra TC52ax first across all the categories.**

Summary

These high ratings deliver results that create measurable productivity gains, reduced muscle fatigue and ergonomic benefits to users.

When it comes to workflow, you want your teams fitted with the best equipment for the job. With enterprise-level devices, you can be confident your team is in the best possible hands—which leads to a more efficient workforce and higher profits.

Overall, the speed and efficiency of Zebra devices—paired with the reduced physical demands and very favorable usability ratings—give workers the best devices to complete the job.